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San Francisco Creek, showing bank improvement, vegetation, and regulated stream flow.

RANGE IMPROVEMENT BY WATER SPREADING

By A. T. Semple and B. W. Allred [1]

FRIJOLE and San Francisco Creeks, sister tributaries of the Purgatoire River in southeastern Colorado, the one an ugly twisting barranca, void of trees or brush along its course, its flood-season waters gnawing gullies in the naked soil; the other a pretty, meandering drainage with thickets and tree growths to its water's edge, present today convincing examples of the over-grazed watershed stream and the stream flowing through land that has known the solicitude of soil-conscious owners. Along Frijole Creek can be seen huge webs of gullies and gulches, cut by the erratic torrential rains which are common in the vicinity, until the whole drainage is in the incipient badland stage. It takes 150 acres of land on Frijole Creek to support one cow.

Over on San Francisco Creek, but a few miles away, the scene presents a picture so different as to be almost unbelievable. There the once abused and barren land has been transformed into a highly efficient farming and pasture unit. Trees grow along the streams, cattle fatten on the rich grasses, and dark green fields of alfalfa thrive on the lower better-watered lands.

The explanation lies in the story of Louis Cortese and his brother Charlie who in the year 1910 began the purchase of a ranch in the San Francisco Creek basin. Today they operate some 3,000 acres of deeded land and 320 acres of leased land. Storm waters are spread on about 2,000 acres from adjoining foothills and mountain slopes. A 30-acre field which in 1910 was principally a prairie-dog town and would not keep a saddle horse, now produces about 2 tons of alfalfa hay per acre. The whole ranch now winters 600 calves with a gain of 150 pounds per head. The only purchased feed is some 100 pounds of cottonseed cake per head.

When the Corteses acquired the land, the San Francisco Creek and its tributaries were wild, uncontrolled gullies which were eating away the heart of the ranch. The hay crop was scarcely worth the harvesting, and an 800-acre pasture which had been overgrazed for many years would not sustain five head of cattle.

Rocks Utilized

The Corteses were men of courage. They gathered up the rocks and boulders strewn over the land and built a barn 200 feet long with rock walls. They used more rocks to check the mountain floods and turn them out where the water would produce forage crops. The lesser gullies were plugged with earthen structures. Then, possessing ingenuity as well as courage,

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Frijole Creek, showing depth of channel and bank cutting, 3 miles from head of drainage.

the Corteses set to work to ditch the flood waters on to hay lands and broad, gently sloping tablelands where now the water is deployed out by an automatic system of spreaders.

A large part of the floodwater comes from 2 square miles of a steep mountain side which has been so grazed, by cattle only, that it has a good cover of shrubs and grass. During the last 25 years no increase in run-off intensity has been noticed. (On similar slopes outside the Cortese properties where goats have destroyed most of the vegetation, the land is slashed by deep arroyos and it takes more and more acres, each year, to keep a goat.)

Torrents Checked

From this steep slope, after a rain, the water rushes in a torrent down its rock-bottomed channel. At times, the force of flow is so great that a horse cannot cross the channel. Occasional floods move boulders as large as 4 feet in diameter. At one point across this intermittent stream, which may run three or four times during the growing season, the Corteses have built a check dam of brush and rocks. The dam is about 12 feet long and less than 5 feet high. The cost was 3 days' work for two men.

This structure lets enough water into a V-shaped diversion ditch to cover about 500 acres. The ditch is 4 feet deep and one-half mile long. Farther down the natural channel there are other similar dams. The second one consists of brush and rocks as does the first, is about 10 feet long, and diverts water for some 120 acres.

Self-Cleaning Ditches

These ranchers have found that it is particularly important, in order to keep down operating costs, that their ditches be self-cleaning. This is especially true where they run through rough brushy land where teams cannot be used. They have one $500 ditch, a mile in length, which had to be abandoned because it has too little gradient and fills with silt. Having to clean a ditch is to them like having to buy the land all over again. For their conditions, where the water carries considerable silt, they like to have a velocity that will carry the silt without inflicting further damage.

From the diversion ditches, spreader ditches made by plowing one to three furrows carry the water on to the high points of the alfalfa meadow and western wheatgrass (blue joint) pastures. Wherever the water concentrates after having covered the land, another spreader furrow picks it up and spreads it again. Generally the spreaders are 100 or more feet apart. As this process continues, the water discards more and more silt and clay, and by the time it reaches the stock ponds it is almost clear. In the Cortese ponds there has been no appreciable silting within the past 10 to 15 years. (Think what that would mean to the life of our large reservoirs!) With seven such ponds, the Corteses have never had an animal bog down.

As for the spreader furrows, generally these become narrower and have slightly more gradient at the farther end.

The sediment picked up on the mountain side and deposited on the pastures is highly valued by these ranchers—this because of its fertilizing value. The initial flow after a long dry spell, being dirty and full of organic matter, is not used for stock water.

We were told by Louis Cortese that this water-spreading system causes 1 acre to produce as much as would 10 acres without it, and this checks very closely

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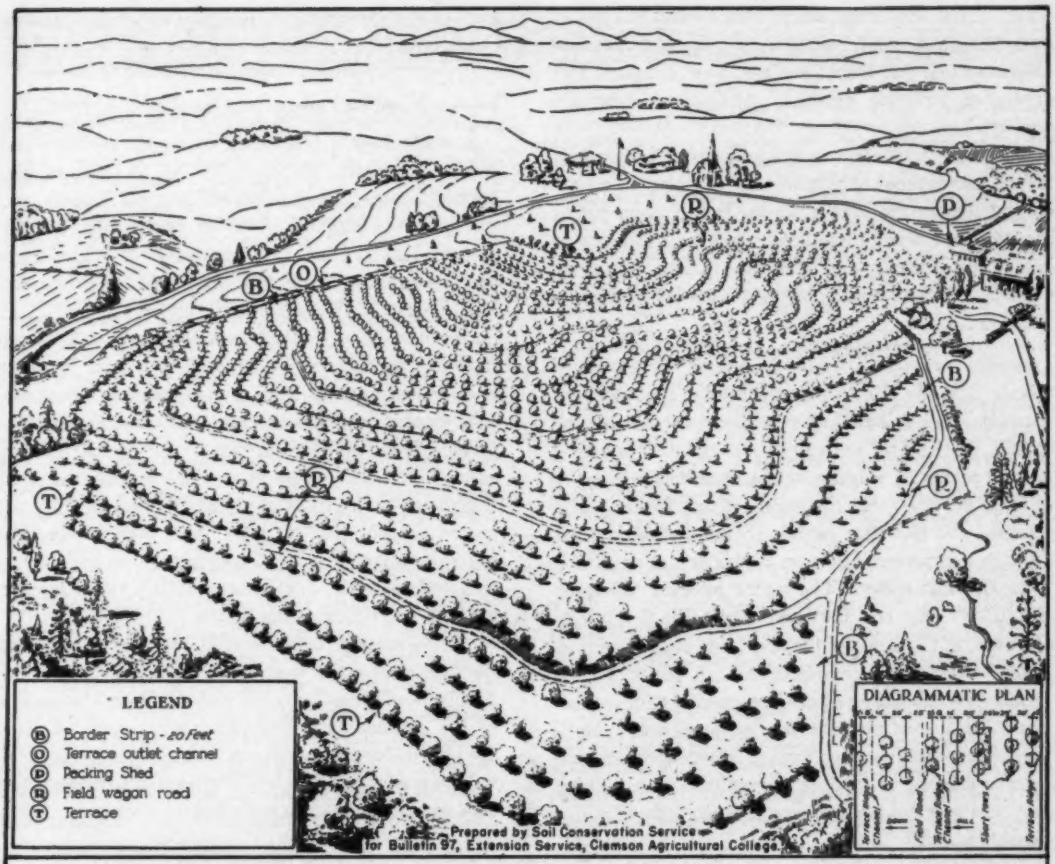
Earth check dam (shown between the two x's) in pasture gully on Cortese property, built 22 years ago. About 200 yards above it there is a similar structure which diverts water for 32 acres of meadowland. The bottom of the arroyo is nearly 15 feet below the top of this dam, which supplies water for 5 acres. It is estimated that the two dams could be built in 10 days by two men with teams and slips. The water for both comes from 100 acres of shaley soil on one side of the hill in the immediate background.


LEGEND
B Border Strip - 20 feet
O Terrace outlet channel
P Packing Shed
R Field wagon road
T Terrace
DIAGRAMMATIC PLAN
Prepared by Soil Conservation Service for Bulletin 97, Extension Service, Clemson Agricultural College.

ORCHARD *Conference*

By C. L. Hamilton[1]

APPLES, pears, and peaches are produced in three-fourths of the States. The total annual production for the United States amounts to more than 150 million bushels of apples, 50 million bushels of peaches, and 20 million bushels of pears. Citrus fruits are grown in the South in the Gulf States and in the West, principally in California the total amount being over 75 million boxes. Besides this, the annual production of small fruits and nuts amounts to several million tons.

The greater number of the orchards and vineyards from which this fruit comes are located on sloping lands where soil erosion may be a serious factor. Field observations indicate that some of the most serious erosion in the country occurs in peach orchards in the South and East and in some of the square-planted, irrigated orchards in the West. The practices of square planting and clean cultivation, without any regard for direction, degree or length of slope, have so accelerated erosion that abandonment of large acreages is often necessary. In many places there is excessive loss of topsoil, and slopes are riddled by gullies. Too often young orchards must be aban-

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doned at the very stage where they should be coming into full production. Others may be carried for a longer period, but the continuous loss of topsoil and expensive fertilizer prevents profitable yields and quality.

In striking contrast, foreign orchards and vineyards are, almost without exception, not only planted on the contour where the land is sloping but in many places are provided with supporting walls and terraces to bench the hillsides and conserve rainfall, to check erosion, and to facilitate proper cultivation and fertilization.

Problem Complex

Some time ago T. B. Chambers, head of the section of engineering, concluded that erosion control in orchards, particularly with regard to the establishment of new orchards, was an important problem in many of the Service demonstration areas. Investigation revealed the fact that practically no published literature or experimental data on the control of erosion in orchards exist today. The recent bulletin, "Orchard Terracing", by the Clemson Agricultural College, Clemson, S. C., is one of the first of its kind to be published. Additional complications are added to the problem by the nature of present orchard-culture practices. Because of the extensive measures that must be used to combat insect or disease infestations, and the direct influence of changes in fertilization or cultural practices on yields and quality of fruit, orcharding is a specialized field.

The Service has a few field technicians who have had some experience and who have devoted considerable thought to the control of erosion in orchards. Also, throughout the regions there are some orchard farmers who for a number of years have been practicing one or more erosion-control methods.

To Pool Ideas

After consultation with the various regional conservators and technical sections involved, it was deemed advisable to hold an orchard conference. By this method it would be possible to pool the limited experience and ideas available and to develop recommendations for basic practices to control erosion in orchards. It was believed that such recommendations would serve as a foundation for the development of a more detailed and complete plan for application in the regions concerned. Approval was finally secured and it was decided that two orchard specialists, preferably an agronomist or horticulturist and an engineer, from each of the interested regions should attend the conference.

Conference Procedure

THE CONFERENCE was held March 15–19, with Region 1 represented by C. A. Frye and John T. Bregger; Region 2 by M. L. Nichols and Ernest Carnes; Region 3, William B. Nivison and Frank Trull; Region 5, W. D. Teare and Ben B. Sproat; Region 10, J. G. Bamesberger and Fred Herbert; and region 11, T. A. Steele, and C. C. Johnson. The Bureau of Plant Industry appointed Dr. F. P. Cullinan and Dr. J. R. Magness to act in an advisory capacity on orchard culture. This group, together with representatives from the engineering, agronomy, and erosion practice sections in Washington, was divided into three committees. One committee considered the development of erosion practices for stone fruit orchards (peaches in particular); the second committee concentrated on pome fruit orchards (apples, pears, etc.); and the third committee was assigned to irrigated orchards, its recommendations to apply especially to the Pacific Coast States.

All committees were brought together in a general meeting during the morning of each day to consider problems of general interest and for group discussions of the various committee recommendations. During the afternoons the committees usually met in individual groups for the purpose of revision or to develop further recommendations on their respective assignments.

Ideas Direct From Field

Field representatives came to the conference with prepared material and lists of the definite problems of their areas. The interchange of ideas resulted in the development of certain basic erosion practice recommendations for orchards, and when the complete report of the conference is compiled and distributed among soil conservation workers it is hoped that the information will partially supply the needs of those interested in this special phase of the work. Such recommendations as can be set forth in this article must of necessity be more or less general. They will be confined primarily to the establishment of new orchards, for it is here that it is possible to introduce the most effective erosion-control practices.

General Recommendations

AS IS CUSTOMARY in all the work of the Soil Conservation Service, the orchard-management problem for erosion control was considered as

RECOMMENDATIONS IN BRIEF

1. New orchards should be set out in areas recommended by the various State experiment stations, extension services, and good orchardists, and subsequent fertilization should be in accordance with their recommendations.

2. In general, it is hazardous to plant orchards on soils where severe erosion is already present or where there is a root penetration depth of less than 3 feet.

3. A systematic plan showing complete lay-out of orchard (tree locations, roads, turn rows, terraces, cover strips, etc.), should be prepared for new orchards before planting.

4. Orchards requiring seasonal cultivation should be limited to approximately the same slopes as are recommended for cultivated farm crops.

5. Relatively steep slopes can be used for noncultivated orchards provided it is possible to establish and permanently maintain an erosion-resistant cover.

6. Contour planting and tillage should be recommended for all orchards except possibly on some of the A slopes.

7. Both winter and summer cover crops, buffer or alternate middle strips, should be used in cultivated orchards wherever possible to maintain fertility and retard erosion.

8. Terracing is recommended if cultivation is practiced during rainy seasons or if adequate vegetative cover cannot be established and permanently maintained. The major justification for terraces in orchards with permanent cover is moisture conservation.

9. Individual terraces for each main tree row, with trees planted on the terrace ridge, seem preferable.

10. Bench terraces are recommended where necessary for steeper slopes to conserve moisture, check erosion, and facilitate orchard work.

11. Furrow-irrigated orchards should generally be laid out and cultivated according to irrigation grades required for uniform water penetration with the furrows serving the dual purpose of irrigation and erosion control.

12. Mulching is an effective erosion-control measure for orchards and its use should be given more consideration.

a whole by all committees. The ultimate objective was to develop a plan of proper land treatment in orchard areas that would check erosion, be practical in its establishment without hindrance to the control of harmful insects or diseases, and would not materially curtail the yield and quality of the fruit or interfere unduly with necessary and desirable orchard practices and culture. In seriously eroded orchards, it may become justifiable to introduce control measures that will temporarily reduce yields or quality, but this will be done only where no other known control measure will adequately retain the soil. The retention of the topsoil and the eventually increased quantity of fruit due to an extended bearing period will more than compensate for a temporary reduction in yield.

Sites for New Plantings

New orchards should be set out only in areas recommended by the various State experiment stations and extension services as having satisfactory soil, climate, air drainage, etc. They should not be set under conditions where severe erosion is already present unless the field is first prepared by an adequate soil-building and erosion-control program. In general, it is hazardous to plant orchards on soils that have a root penetration depth of less than 3 feet. High water table, rock strata, or impervious clay subsoils usually mark the limiting depth of root penetration. This general standard of 3 feet should be increased somewhat as we go westward into the section of less rainfall, and it may be decreased slightly in the Northeast where moisture conditions are more favorable. Orchard fertilization, spraying, and general management should be in agreement with State experiment station recommendations.

Lay-Out

A detailed topographic map showing a complete and systematic plan of necessary terraces or outlets, permanent structures, roadways, or cover strips, as well as all tree locations and row arrangements, should be made for the entire orchard site. In making the plan, it is particularly important that such factors as equipment to be used in tillage, and spraying and harvesting methods be considered. Roads leading to the orchard should be sodded or otherwise protected from erosion, and definite sodded turn rows of ample width should be provided in all orchard lay-outs. Straight radial rows can be incorporated in contour-planted orchards provided there is assurance that all erosive field operations will be conducted on the contour. Straight cross rows are often desirable for the purpose of facilitating orchard work.

Stone Fruit and Other Cultivated Orchards

FOR THE DEVELOPMENT of erosion-control practices, orchards that require complete or partial cultivation can be considered in the same general category as field-row crops. In general, the same slope limitations and erosion-control practices should be applied. On A slopes the necessary tillage should be mainly across the slope, with the final cultivation always across the slope. Both winter and summer

cover crops should be used wherever possible for the maintenance of fertility, to keep up the organic content of the soil, and to prevent erosion. On slopes approaching the B classifications, contour planting and cultivation should be considered; and where the slope is definitely B or BB, contour planting should always be used. Additional recommended practices for the B and BB slopes are terraces, buffer strips, cover crops (alternate middles) and contour tillage.

Cultivation and Cover

No cultivated orchards should be planted on C slopes unless adequately protected by bench terraces. Critical slopes in fields often should be left out of orchards and planted to permanent vegetation. At the present time there seems to be insufficient evidence as to the advisability of attempting permanent sod in peach orchards. This is due to its effect on the tree yields and growth. It is generally felt, however, that clean cultivation or the neglect of covers is overdone in the majority of the regions. Permanent buffer strips have been found satisfactory in many areas. Other sections recommended cover on alternate middles, and these should be rotated annually or at regular intervals. If possible, new strips should be planted before the old strips are plowed under.

Pome Fruit and Other Noncultivated Orchards

WHERE THE ORCHARD is maintained in permanent sod it is not necessary to limit the slope of the land for orchard planting—that is, providing the farmer is willing and that it is possible to follow adequate erosion-control practices. This implies permanent maintenance of adequate cover. Alfalfa and sweetclover should be recommended as permanent cover only on soil with a high water-holding capacity, where rainfall is ample, and where the soil reaction is suitable. In order to establish an erosion-resistant cover, it is important to include some grasses with the alfalfa and sweetclover. The perennial or self-reseeding annual grasses or legumes, such as the lespedezas, should be used in other areas. Grass mixtures are usually recommended because of the denser cover and because there is less chance of seeding failure.

Production of adequate sod should be assured by the application of lime and fertilizer in accordance with good pasture practices for the respective locality. This application should be made in addition to that for the normal requirements of the trees. It should also be borne in mind that when the orchard is kept in permanent sod cover the tree will require more nitrogen than when clean tillage is practiced. When it is necessary, due to a root-bound condition, to break the sod in orchards on sloping land, this should be done in alternate middles on the contour.

Care of Permanent Sod

Mowing of the orchard is recommended especially where moisture conservation is necessary. Where weed control or moisture conservation are not controlling factors, mowing should be delayed until the grass is practically mature. Mowed material should be left where it is cut or spread under the branches of the trees for mulch. But all vegetation should be kept 2 or 3 feet from the trunks, to avoid providing a harbor for mice. A small amount of hoeing directly around the tree is particularly desirable in young orchards. The cut material should never be used for livestock feed because of the possibility of poisoning from spray residues and because of the loss of fertility to the orchard. Fire-control practices such as cultivated fire lanes on the contour or across the major slope should be maintained where there is a fire hazard.

Where permanent sod is maintained, the major justification for terraces is moisture conservation. Since some overtopping is not harmful under these conditions, level terraces are usually advisable. In certain areas where soils are very impervious the use of graded terraces may be necessary, especially where a good sod cannot be established. Better moisture distribution over the entire terrace interval may sometimes be secured by using contour furrows between terraces, but where a good sod cover is maintained it may be satisfactory to use contour furrows alone.

Irrigated Orchards

WHERE FURROW irrigation is used, orchards must be properly laid out so that correct grades for uniform rates of water percolation and minimum scouring can be secured. In furrow irrigation short rows should be used; this will cut down the head of water and secure proper distribution. The length of runs, however, is governed largely by the type of soil and other field conditions. The irrigation furrows should be constructed so that they will serve the dual purpose of irrigation and erosion control. If the overhead method of irrigation is used, provision must be made to take care of storm water by vegetative or mechanical means. In all new orchards, tree rows should be laid out so that the irrigation and tillage can be accomplished on nonerosive grades.

In established square-planted orchards on sloping lands, there is no practical method of avoiding erosion

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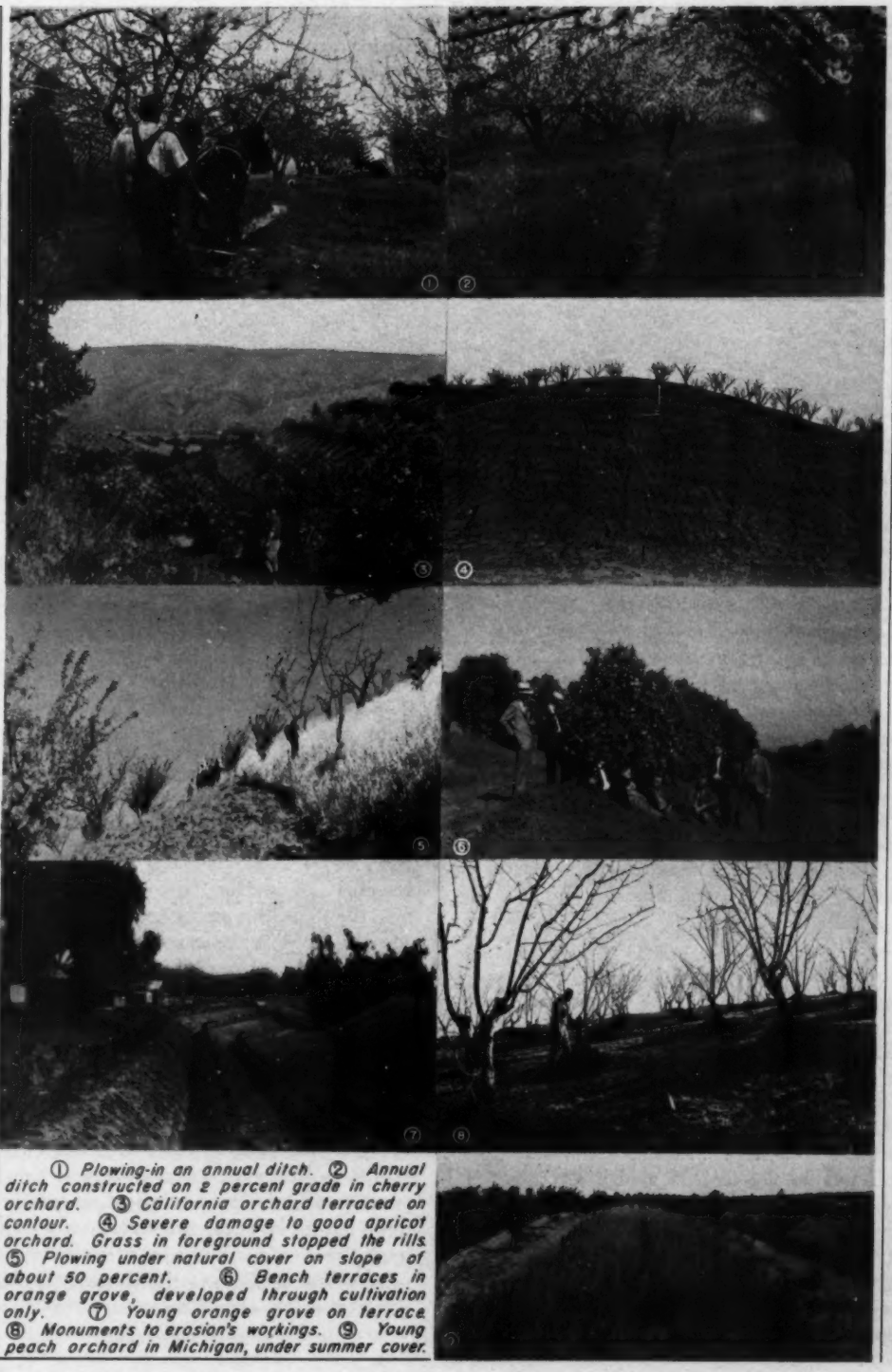

① Plowing-in an annual ditch. ② Annual ditch constructed on 2 percent grade in cherry orchard. ③ California orchard terraced on contour. ④ Severe damage to good apricot orchard. Grass in foreground stopped the rills. ⑤ Plowing under natural cover on slope of about 50 percent. ⑥ Bench terraces in orange grove, developed through cultivation only. ⑦ Young orange grove on terrace. ⑧ Monuments to erosion's workings. ⑨ Young peach orchard in Michigan, under summer cover.

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with furrow irrigation except by the use of adequate cover crops. An alternative by which erosion may be partially reduced is to run the irrigation furrows diagonally, at the same time securing the best possible grades. This, however, will involve a revision of the irrigation system.

Since cover crops are of primary importance in erosion control, further investigation is needed to determine suitable species for irrigated orchards under western conditions with particular emphasis on their moisture requirements. Heavy users of moisture deplete available water and may necessitate additional irrigation water. Where conditions permit, the possibility of using a suitable cover crop should be thoroughly explored before resorting to other methods.

Terracing

IF THE ORCHARD site soil is erodible, if clean cultivation is to be practiced, or if an adequate vegetative cover cannot be established or permanently maintained, it is recommended that contour planting and terracing be completed immediately prior to or subsequent to planting. It is really preferable that the terraces be constructed wherever possible before the trees are planted. Where terraces may not be provided for each tree row prior to planting, master terraces at the regular terrace interval should be constructed. This will provide protection to the intervening rows while their respective terraces are being developed by subsequent tillage operations. Bench terraces should be used on the steeper slopes where the construction and maintenance of ridge-type terraces is impractical. After the initial ridge with water channel has been constructed, the benches are usually developed by orchard-tillage operations and in connection with vegetative strips between the rows.

A terrace for each main tree row seems to be preferable, and it is felt that the trees should be planted on the terrace ridge. With this practice the size of the terraces will depend somewhat on the spacing between tree rows. When trees and terraces are established in this manner each row of trees will have more uniform soil and moisture conditions. The terrace ridge usually contains a high percentage of topsoil, and the concentration of moisture in each terrace channel immediately above the tree rows should give the most favorable growing conditions.

In terraced orchards some deviations from normal tree spacing may be advisable. When a terrace is used for each row a wider spacing between rows, with a closer spacing within the row, will reduce terracing costs per acre. It will also facilitate contour cultivation and equipment movement within the orchards, and will still provide the same number of trees per acre. The usual procedure of providing suitable terrace outlets, nonerosive grades, and ample terracing channel capacity should be followed for orchard terraces. The latter is particularly important where overtopping would be detrimental. Systematic maintenance work should also be emphasized.

Where square-planted orchards are already established, terracing becomes very difficult without seriously damaging the trees. In the majority of old orchards, terrace construction is usually impractical. If topographical conditions permit, regular terraces should be constructed only in old orchards where the benefit by increased life and moisture conservation will overbalance the loss (normally anticipated) by the removal of trees. Some growers estimate that terrace construction is practical when not more than 8 percent of the trees have to be removed. Usually standard spacing and channel capacity should be provided for terraces in old orchards.

Mulching

THE APPLICATION of mulch as an erosion-control measure in orchards and vineyards should receive much more attention. This is especially true under conditions where a permanent sod or semi-permanent cover crop is difficult to maintain, and where available moisture is limited. Mulch in orchards effects much the same kind of erosion control as leafmold and litter in the forest. An advantage of mulching over cover cropping is that the mulch will conserve moisture for the trees instead of taking it from them. With a proper depth of mulch, weeds are eliminated and, as the straw or other mulching material rots, organic matter is added to the soil.

The use of mulching materials for the purpose of erosion control will depend upon their availability or cost and their adaptation to the particular orchard crop being grown. On certain areas it may be good practice to set aside a definite portion of a farm for the sole purpose of producing mulch for the orchard areas. Insect or disease control may be a factor to be considered as well as fire hazard. The former may be partially offset by not placing mulch directly against trees, and the latter can be overcome to a large extent by applying only around trees or in alternate strips or rows. When applied in strips, however, mulch should be laid as nearly as possible on the contour.

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On Opposite Sides of An Old Soil Fence

By Helen M. Strong [1]

North slope of Palouse hill showing old pioneer soil fence to the left of the modern wire fence. Grazing has been unregulated on the left-hand, bare field, but a thick stand of bunchgrass has returned on the right-hand field since grazing was regulated in cooperation with the Soil Conservation Service. Six miles southwest of Pomeroy, Garfield County, Wash.

ON THE slope of a hillside in Garfield County, Wash., there is a long ridge of soil extending from the valley flat straight up to the top of the hill. This is one of the soil fences thrown up by early pioneers to mark the boundaries of their lands. Most of these soil ridges have been plowed over until they are obliterated, but this one remains, fortunately, as a record of those times when soil instead of wood was used in the Palouse hills for fencing. Today, alongside it, appears the modern post and wire fence.

When this soil fence first was heaped up, the hillside was covered with a dense, soft stand of bunchgrass. As time passed, however, constant, heavy grazing kept the grass eaten down close to the roots, leaving the range with only a weedy growth. Apparently the bunchgrass was all destroyed. Today the fields on the left of the sod fence are denuded of vegetation, while in sharp contrast those on the right are covered with a thick stand of bunchgrass. No seed was planted, but roots and seeds dormant in the soil were given an opportunity to grow. The contrasting fields, marked by the old soil fence, illustrate definitely what can be done to reclaim denuded slopes in the area.

The picture was taken on October 30, 1936. For the preceding 18 months, grazing on the right side of the fence had been regulated in cooperation with the Soil Conservation Service, while on the other side every spear of grass continued to be foraged. On the one field soon there will be neither soil nor forage, the land a liability to the owner; while from the other there will a be steady and increasing animal income from a stable feed supply.

There is no doubt that the condition presented on the bunchgrass side of the fence represents the natural condition on these ranges. The miles and miles of nearly bare hillsides, today criss-crossed with cattle trails, do not in any degree represent the scene as it lay before the eyes of the first travelers through this area. As for the bunchgrass, it is now found only on an occasional rocky spot which is inaccessible to cattle.

Contrast in Vegetative Cover

A little more than 20 years ago there were some fine stands of bunchgrass on the Colville Indian Reservation in Washington. Indian grazing in those areas had not been severe, so that the grass remained

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A luxuriant stand of native grass on Henry's Fork, Sweetwater County, Wyo. This view, taken by the Hayden expedition in 1870, provides a convincing contrast to the present-day denuded condition.

A stand of bunchgrass on the Okanogan Plateau, Colville Indian Reservation, 1912. This represented essentially a virgin condition, since it had been utilized only for scattered Indian grazing. The grass reached almost to the horses' knees. The taller vegetation may be needlegrass. Photograph by J. T. Pardee, U. S. Geological Survey.

almost in its virgin state, while outside the reservations it already had been grazed down to the roots. In fact, so heavy and rich was the grass when Pardee went through it in 1912 that the horses of his pack train, hungry after the thin forage outside the reservation, continually stopped to eat and had to be urged along. The same thick stand was found at that time also on the Okanogan Plateau and in the Columbia Valley, where it grew to the horses' knees.

The Hayden surveying expedition of 1870 found this same rich stand of grass in Utah and Wyoming, a vivid contrast to present conditions in areas where

A fertile grassland valley on Henry's Fork, near its junction with the Green River, Daggett County, Utah, 1870. Note the high stand of native vegetation, principally western wheatgrass, and the smooth, uncultivated valley floor. Today, the cover is missing and the valley floor is serrated with deep gullies.

weeds, annual grasses, and other growths of less forage value have replaced it in some places, and sagebrush, the secondary member of the original sagebrush association has become the dominant plant in others.

Grasses Destroyed—Gullies

In those early days the bottom lands and slopes not only were covered with a thick stand of grass, but they were smooth and unscarred by deep gullies. Grass cover was sufficient to hold the soil, even under the impact of heavy downpours on the slopes. This same grass controlled flow of water so that floods did not cut gullies into slopes, over roads and fields, and into the lower level areas. Then, the Palouse Hills around Pullman and Moscow did not show gullying nor had the best of their topsoil been washed or blown off. Now, removal of the climax vegetation that through long periods had established itself has started an entirely new erosion cycle. If allowed to continue it will wear down these hills, lower the water table, and finally, after ages, another climax vegetation may develop; but neither the present generation nor their children and children's children will be concerned with this. The immediate heritage will be bare soil, rough land, and a mere subsistence or starvation condition unless the balance soon is restored in some measure.

To Restore Natural Conditions

Restoration of this balance is the aim of the Soil Conservation Service, whose work now is to stop the vicious cycle induced when the soil lost its protective cover. An opportunity is being given for natural forces to reassert themselves in reestablishing vegetation, to hold and stabilize the soil by protecting it against unnecessary losses. In this settled land present day farm conditions must be met, so that the land will support its population in the present or a higher standard of living. This means crop agriculture, not grazing alone, and the Soil Conservation Service is solving the problem of a crop and animal agriculture which will use the soil and at the same time save it for future generations.

Climatic Studies Needed

Although changes have occurred in vegetative cover, lay of the ground, and soil, it is important to remember that today we are working under the same climatic conditions as existed in the early days of exploration and settlement. Climate is characterized by the same diversity of wet and dry years, sudden torrential downpour, and long dry periods, heat of summer and cool or cold of winter, and strong winds, as have prevailed throughout historic time. To be sure, more information is needed regarding the climate of different parts of the area. Such records as exist indicate that climate varies greatly from place to place, even within short distances. A sound soil-conservation program must be based upon the climatic conditions existing on the spot, not as they are a few miles away where records may have been kept.

Farmer Cooperation

Land owners in the Pullman-Moscow area have united with the Service to develop a sound long-time agricultural program. Here for years hills had been cultivated from base to summit. The heavy plows, drills, and combines were pulled straight up and down these hills, first by teams of many horses, then by powerful tractors taking a heavy toll of fuel on the long grades and thus eating into farm profits. Even when seed had been sown it might be washed or blown out and the work go for naught.

Now, under the program, fields are protected by incorporating the wheat stubble instead of burning it. This holds the soil down through the period of fallow, breaks up the flow of water over the fields, retaining it in small hollows so that it soaks into the ground instead of running off. Rough land at the base of the

hills is sown to grass and kept for pasture. That on the summits where soil may be thin or where snow banks form each winter also is kept in pasture, leaving the smoothest and best part of the hillslope for crops. On the top of some of the Palouse hills they are planting windbreaks, using such trees as caragana, black locust, and Russian olive, which are adapted to the conditions of rainfall and temperature existing in the area. These will help to hold the snow, preventing the melted snow water from rushing down over the crop land and carrying away the soil.

Better Income From Smaller Crop Area

It is interesting to note that this smaller crop area around the hillside affords as good an income as that derived from cultivating all over the hills. Yields on the rough land at the foot of the hills and on the poorer soil of the summits were not so large as on the better soil of the midslopes. Furthermore, it costs more in tractor fuel and in labor and time for planting, cultivating, and harvesting the summits than the areas lower down. Another change in tilling the slopes, namely contour cultivation, permits machinery always to move on the level, with less expenditure of fuel and labor.

Around the foothills of the Blue Mountains an original fertile soil combined with climatic conditions has invited agriculture—first grazing, then grazing and wheat, then wheat, then the raising of peas for canneries located in such places as Dayton and Athena in the valleys. This general area has an elevation of 2,000 to 2,500 feet above that of Pullman, and consequently has a higher precipitation and humidity and a shorter growing season. For example, on the lowlands at Dayton the Pullman conditions of climate exist, precipitation progressively increases as the mountains are ascended above the town to timber line, and frosts are later in spring and earlier in the fall. This has been an advantage, for a farmer can prepare his land in the valley, seed it, then go on up to his higher acres, prepare and seed that. Harvests likewise come in similar succession, from valley bottom to timber line.

Intensive Land Use

In short, conditions that might be found in locations separated as to latitude are found compressed into a small compass around these Blue Mountain foothills. Labor and machinery on the land and in the pea canneries can be kept busy during a longer growing season than where the land is level, and market demands met for a longer period of time. All these elements have contributed to somewhat intensive use of the land, leading to severe soil use with absence of protective cover against wind and water; to loss of soil through sheet wash, gullying, and wind erosion; and in many places to cutting up of the smooth land surfaces by gullies. On more than one hill slope, soil has washed off down to the rock, or yellow clay spots of subsoil are appearing.

Here around the Blue Mountains is an area of farm lands and prosperous towns dependent upon maintaining the standard of soil fertility and an unscarred land surface. The problem was not one that could be solved on a single farm, for the interests of each farmer were linked with those of his neighbor, and those of the entire community intertwined.

The Service has mapped and studied the needs of the land and of the farm communities as to land use. Where the soil is badly washed or eroded it is being put into permanent pasture. Pulverizing the soil and keeping it bare during fallow is becoming an obsolete practice. The farmer has discovered also that by incorporating stubble and practicing a system of rough tillage he attains larger crops. He now plants with a disk drill, instead of a hoe drill which would drag up the stubble. Until recently, disk drills were not found in the stock of merchants handling agricultural supplies. Now every dealer is featuring them, because they are in demand under the improved farm practices.

On slopes which are so steep that erosion would result from continuous wheat or pea cropping, buffer contour strips of grass have been established to decrease run-off. On higher elevations approaching the Blue Mountains, where soils are heavier and rainfall higher, peas replace summer-fallow in the rotation; but farther away from the mountains at lower elevations where it is too dry for peas, summer-fallow is the rule between crops of wheat.

Luxuriant stand of bunch grass in 1912 on Okanogan Plateau west of Omaha Lake in Colville Indian Reservation, where up to this time there had been only scattered Indian grazing. Photograph by J. T. Pardee, U. S. Geological Survey.

When the first settlers came into this country, they found grass-covered or forested slopes without gullying, and smooth valley bottoms. Streams were fringed with cottonwood and willow. There was a natural balance between erosion, vegetation, and rainfall. Wild Horse Creek, flowing through Athena, was at that time a clear stream, across which anyone could step. It flowed through willows and grassy meadows. Water seeped into it from underground drainage, coming in slowly from grass- and forest-covered soil. Although heavy rain has always fallen upon this land, the mat of vegetation took care of it and kept the streams clear and even in flow.

After the fields were cultivated, when heavy storms brought sudden high floods into Wild Horse Creek its channel was cut down until the stream flowed in a straight-walled dirt arroyo 20 to 25 feet deep across a fertile cultivated and grazed field. Cattle no longer could reach the stream for water, nor could it be crossed except where bridged. It continually was deepening and widening, threatening the entire field. About a year ago the Soil Conservation Service installed wire and rock dams a mile apart on this stream and since then the channel has filled in 6 or 8 feet. Now earth slumps remain where they fall from the sides, vegetation is taking root on them, and the entire channel is becoming stabilized. Eventually it will be a shallow grassy depression through the field.

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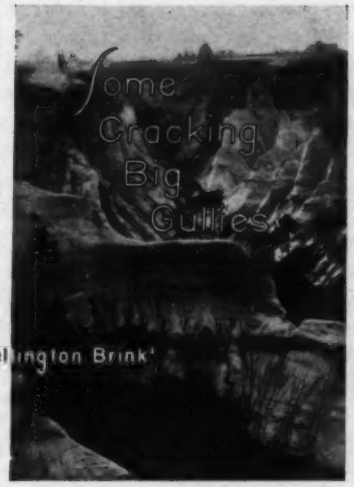
A silt flow 2 feet deep inundating a rock road. The silt is from a finely tilled summer-fallow field where the stubble was burned several years in succession. Severe sheet washing occurred over the entire slope, and gullies are starting in almost every depression. Whitman County, Wash.

The wheat stubble on this field has been chiseled and incorporated, a rough tillage method which controls run-off. A 3-inch rain did no damage.

SOME CRACKING BIG GULLIES



By Wellington Brink[1]

THE gullies of Stewart County, Ga., like the dust-storms of the West and the floods of the East, give fame and focus to the fact of soil erosion.

Stand at the end of a bean row, with Doomsday at the tip of your toes, if you would be convinced. When the earth is crumbling all around, there can be no gainsaying that an agricultural judgment day is close at hand.

It is good earth—bale-to-the-acre land, much of it—that is hurtling into the Stewart County pits. Good earth, in chunks weighing 1 ton, 2 tons, 5 tons. Not soil easily spared, as sometimes intimated; not a recumbent desolation surrendering to a wide-mouthed chaos. I don't think I ever saw lustier collards, cabbage, peas, onions or potatoes than on the farm of W. T. Halliday. Yet, week by week, month by rows are shortening, the vegetable patch is getting smaller, the farm is dropping away forever and for aye. There's a peach tree at a crazy angle, given brief reprieve on a ledge a few yards down, bursting bravely into bloom. There's a wire-and-picket fence tenaciously thrusting 6 feet beyond the edge of an abyss; no going around or climbing over today, mister. There's a persistent potato plant growing down yonder where no garden fork will ever reach it.

THE earth trembles and the thunder rolls, in glowering paradox to blue skies and sunshine. That's the artillery of soil erosion, with the customary mufflers off.

How deep is this gully? How deep is Providence Cave? How deep is Halladay? How deep is Rutledge? I toss out horizontally one pebble, then another and another. It is, roughly, 3½ to 4 seconds from the beginning of the fall to the kicking up of dust down below. The pebble drops at 32.16 feet per second. My mathematical friend calculates the depth at from 197 to 257 feet. He uses a simple method, with the factor of friction ignored—but it's close enough. And not even a Euclid can accurately estimate the cubic yards that have been swallowed by one of these gullies, for the dimensions increase and the totals leap even as the pencil moves.

IF the pebble were animate and the seconds were hours, I wonder what it would think as it makes the descent? It's a pretty swift tumble at best, in view of the geologic ages which went into the creation of the structure that has been so completely devastated within the past 60 to 80 years. There, in bold cross section, is the so-called "A" horizon—the productive surface layer; the underlying "B" horizon—likewise, aeons in the making. That which delights the eye of the artist as he stands in the presence of the Grand Canyon is also here, a little less lavishly—the craggy grandeur, the cathedral architecture, the complete spectrum. Colors fluctuate from reddish bay to dappled gray, from chaste white to royal purple, from lemon chrome to variscite green.

IT'S a spectacular scenery. Sightseers come hundreds of miles to look at it. But it's a scenery that Stewart County could do better without. To make the scenery, considerable property has been engulfed. In the last 2 years many writers have marveled at the immensity and rapidity of the damage that has ensued since the coming of the ax and the plow. They seem pretty well agreed that it was simply the pine-tree pins and the grass damask that held the land in place.

I COMMENT on a slender minaret with one doughty tree like a flagmast at its tip. "There were four trees last year", says Dasher, project manager. "Another 3 months, and there will be none."

The big gullies involve some 70,000 acres. And the giants grow fast and faster, as if stimulated by an overactive geologic gland. The lengthening process continues until the top of a ridge is reached. Highways are moved over and over again, and still they cannot get far enough out of the way. You can see the old roads of last year and the year before, where they run to meet a gully, pause for a jump of 15 or 20 yards, resume on the far side.

[1] Editor, Soil Conservation.

Go down one road far enough, and you come to a veritable delta—great beds of silt, once productive soils, now a problem in themselves. You see a 20-acre lake on your left, a 40-acre lake on your right, backed up by natural dams. "I caught a 9-pound bass there last year", says someone, with a nod of his head.

CAN'T something be done to check the process, to stabilize these gullies?

Well, you can't slope their banks with a bulldozer, plant their sides to Bermuda grass and black locusts. That sometimes serves admirably in South Carolina or Tennessee. But to do that here would be like handing the job to a child with a sand shovel—and you'd lose your bulldozer in the bargain.

How about it, Dasher? How about it Storey? How about it Chapman? How about it Bailey? Is there nothing you agronomists and engineers can offer as a possible solution?

Well, there is plenty that can be tried, and it's the kind of a challenge that commands serious effort.

HERE is one road in proximity to a gully head that looks as if it might not have to be shifted any more. That's because the Soil Conservation Service tried the expedient of a diversion ditch. The water from the slope above is carried along 700 feet or so to a point where it can be emptied into dense woods which spread it and slow it and nullify its abrasive powers. The ditch is 18 inches deep, 4 feet wide, inexpensive to construct. And I am told that it, and a number of other similar structures, are proving of some value.

Kudzu is another recourse. It has been tested on a small scale, and a more extensive use is in prospect. In view of the limited sources of seed, R. Y. Bailey, regional agronomist, is suggesting the use of two-node cuttings and of coils of vines, where supplies are available. He wants to see kudzu well established around the rims of some of these gullies to a width of 50 feet or so. He thinks there may be a chance that a thick matting of the vines will give the banks a tendency to crumble slopingly instead of vertically, and that the perennial once established will continue to grow and bind after further cave-ins. He has in mind the stabilizing effect of kudzu on smaller gullies, notably the one near Buena Vista, Ga.

COMPREHENSIVE soil-conservation measures on watershed farms are not being overlooked. If run-off can be allayed by better land use, there is a chance that the situation will be improved. I have before me the cropping plan of a 473-acre farm that drains into one of the angriest of the big gullies. It carries the specifications for 1937, 1938, 1939, 1940, and 1941. It shows 26 acres retired from pasture to kudzu within the 5 years; 4.5 acres retired from cultivation to kudzu; 15 idle acres planted to kudzu; 9 idle acres put in forest. In place of 8 acres in small grain in 1936, there will be 53.55 acres so planted. The acreage in hay will be materially increased. Rotation by strips on the contour, will be in vogue henceforth. Terraces and terrace outlets will be properly constructed on slopes requiring such protection. (It is interesting to note that 10 million kudzu plants are being planted in the region—Ga., Ala., N. C., S. C., Va., Miss., Fla.—at this time.) This is the sort of intelligence in land use which, multiplied throughout the watershed, undoubtedly will help to save soil, water, and gully thievery. Whether or not the cracking can be stopped, remains to be found out.

An Old Soil Fence

(*Continued from p. 280*)

Farther up on Spring Creek, a tributary of Wild Horse Creek, may be seen today an excellent example of stream-flow control by means of the small pole dam. This creek, formerly clear and constant in its flow has in the past few years regularly became dry. The pole dam built by the Service holds the water back and prevents floods below. Even during the past dry summer which was equally as dry as those of preceding years, this stream has flowed continuously. A fence formerly close to the stream has been set back about 20 or 30 feet, affording an enclosure where cattle cannot graze. Within these 12 months, although no seed has been sown, bunchgrass has come back into this small enclosure and has spread up from the stream 10 or 15 feet—evidence of the raised water table.

A short distance below this point a large gully had worked it way back from the stream into the bluff. It was fed by run-off from a plowed field, and was cutting into a plowed wheat field, the run-off from which continually enlarged, widened, and deepened the gully. This wheat field was one upon which the farmer depended for a good crop, but the gully and the loss of topsoil through the gully was fast destroying the field. In order to protect his field, the farmer urged that wire check dams be placed across gullies. This was done and at the same time the farmer abandoned his practice of plowing furrows straight up and down the hill and substituted contour plowing. In addition, after his wheat was harvested, he incorporated the stubble. A number of heavy rains have occurred; yet under present conditions no water has run off the field to back up behind the wire dams in the gully, although it was the rainfall from this very field which created the gully. No more vivid illustration can be found of the effectiveness of gully-control work.

Constructive farm practice now is no longer confined to the areas of soil-conservation projects. Passing along the road through farms adjacent to the project, one is impressed with the way in

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SOIL CONSERVATION AND THE C. C. C.[1]

By J. G. Lindley[2]

THE Civilian Conservation Corps is an organization carrying forward a broad national program of conservation—conservation of natural resources and of human resources. Its administration is under Robert Fechner, Director of the Emergency Conservation Work; and the operation of the camps is the joint responsibility of the War Department and a Federal using service. The using service may be any one of a number of bureaus or services under one of the Federal departments of the United States Government.

The Soil Conservation Service in the Department of Agriculture is one of these cooperating agencies. Camp educational advisers have been furnished copies of an outline of instruction in erosion control. Many camps are already carrying on courses in soil conservation, and others plan to do so in the future. For that reason, it might be well to explain something of the background of the Soil Conservation Service, its objectives, and its work program.

PERHAPS the most important reason for carrying his message on to the enrollees is that a large number of them are from farm homes. They will go back to their farms. If we, through work in the fields, and through the educational program in the camps, can give them a clear idea of the need for soil and moisture conservation, and tell them how they may adapt this work to their own individual farms, our program of conservation will be advanced very materially.

Last summer duststorms choked the western plains. Any of you who has ever been in one of these duststorms will know the horror and despair that they may cause. At the same time that the Great Plains Region was crying for moisture, floods were surging throughout the East. Also at the same time, thousands of once productive acres in the South lay completely abandoned, worn out by erosion. Duststorms in the West, floods in the East, abandoned farms in the South—all these are due to a single cause—the failure of man to take steps to retain moisture where it falls, or in the case of excessive rainfall, to conduct the surplus water safely from the fields. As early as 1873, over 60 years ago, Elisee Reclus, the famous French geographer said: "Among the causes which, in the history of mankind, have effected the extinction of so many forms of civilization we must place in the first order the reckless violence with which most nations have treated the soil which nourished them."

There is, then, a definite need for erosion control, whether it be by the Soil Conservation Service, Forest Service, T. V. A., or some other Federal or State organization. The main thing is to make the public aware of the necessity for soil conservation, and to get the job of demonstrating erosion-control measures done and done properly.

THE using services have no authority in the educational program—no official responsibility; but we do have an ethical responsibility, and if we fail to do all we can to make the enrollee a better man and a better citizen, we shall not have completed our task, even though every gully in the United States is plugged.

The Soil Conservation Service is a new organization. It is even younger than the C. C. C. It was not until April 1934, a year after the C. C. C. first started, that we received our first camps. Twenty-two camps were allocated to what was then the Soil Erosion Service. Public reaction to the work of the camps warranted their continuance and their increase in number. Today, the Soil Conservation Service is operating 156 watershed demonstration areas and 450 C. C. C. camps.

I might point out here that the Soil Conservation Service is not a relief organization. Its work is forwarded on a cooperative basis with the farmer. In each area, a comprehensive demonstration is made of practical methods of erosion control suitable to that particular area—work that the farmer himself can carry on after the camps have completed their demonstration and moved to other areas where their work is needed. Neither is the service a reclamation organization. No efforts are being wasted in trying to reclaim land where the soil is irrevocably lost. We are trying to save the good land that still remains.

ACCOMPLISHMENTS of the Service must be measured largely in terms of influence upon agricultural thought and action, inasmuch as the program thus far has been based primarily on the principle of demonstration. Indicative of this influence are the results of a recent survey showing that 35,500 indi-

[1] Excerpts from a paper presented at Fourth Corps Area C. C. C. Conservation and Education Congress, New Orleans, La., Feb. 26-27, 1937.

[2] Head, E. C. W. operations, Soil Conservation Service, Washington, D. C.

vidual farmers within the demonstration areas are cooperating voluntarily in applying a complete soil conservation program to their land. Of far greater importance is the fact determined in the same survey that conservation farming practices employed within demonstration areas of the Service already have spread to nearly 55,000 individual farms outside of Service work areas. Such spontaneous acceptance of these practices indicates a widespread and rapidly growing consciousness of the need for land preservation, and constitutes a criterion of the extent to which farmers of the country are translating this consciousness into action.

Let me again state that we hope to assist, not only the farmers, but also the 70,000 boys who are enrolled in S. C. S. camps. We are very anxious to make the soil-conservation courses in the camps interesting and effective. As we are a new organization, I am sure that in the past our men have been somewhat reticent about cooperating in the program, possibly feeling that they might step in where they were not wanted. I am equally sure that the feeling must be and is being dispelled, and I wish to assure you of our desire to cooperate in this all-important work. In Soil Conservation Service camps technical men will be available to aid in instruction if the advisers so desire. Outlines of unit courses to continue the present lessons in soil conservation, soil, agronomy, engineering, and woodland management into the more advanced stages are in preparation.

Orchard Conference

(*Continued from p. 276*)

Rates of mulching will depend upon several factors, such as the kind and cheapness of material used, slope, type of application, etc. Where mulching of "bald spots" is practiced, at least 2 to 3 tons per acre will ordinarily be required to control erosion. This practice is gaining favor in many areas. For some areas contour furrows combined with mulching may be advisable to provide the necessary moisture conservation.

Conclusions

FORMULATION and application of erosion-control practices for orchard lands present new problems, the details of which differ from those encountered in areas devoted to annual field crops. Due to the large acreage and wide distribution of orchards the problem is serious for the nation as a whole. Some orchard soils are being eroded so rapidly that the growers are becoming alarmed and are willing to comply with any reasonable recommended practices which will save the soil and thus, the trees, Many of these growers realize that if their orchards are to continue to be productive they may have to sacrifice temporarily some production and income.

Various erosion-control methods are being practiced by progressive orchardists; in fact, the program which the Soil Conservation Service hopes eventually to inaugurate will not be entirely original. Several methods of soil conservation have been tried by one orchardist or another. Few of them, however, have included all of the soil-conservation principles on individual orchards. It is believed that the greatest accomplishment will be achieved by developing a more complete erosion program for orchards and by helping each orchardist to become familiar with all applicable measures, their application and proper timing of operations. Whether it be sowing or turning under of cover crops, the construction of terraces or annual furrows, subsoiling or cultivation, or the application of fertilizer, the time it is done and the local details involved will be important factors in obtaining favorable results.

An Old Soil Fence

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which farmers have adopted practices which they have seen carried out within the project areas. However, there is need for a much wider spread of constructive land use. In passing through such areas as the Umatilla, Snake, and Yakima Valleys, with their fertile areas, green even in late October under the mild lowland climate of the "Banana Belt", one cannot but feel the necessity for changing farm practices, and the significant interrelationship of hillside watershed and irrigated valley land interests. Here luxuriant crops of vegetables, apples, pears, and peaches can be grown only because of the fertile soil, the warm climate with its long growing season, and the supply of water. Eliminate any one of these three factors and the entire agriculture of the valley with its accompanying town life and market distribution probably ramifying to the Atlantic and the Pacific would disappear. The climate cannot be changed, the soil can be kept only if the land is properly managed; it is the water over which man has the most control.

Irrigation Problems

The irrigation water comes into these valleys from streams whose flow is made steady by forest and grass cover on the watersheds. Should the water flowing through the irrigation ditches become laden with silt, it would tend to clog the pore spaces in the soil, and finally prevent percolation of water down below the surface to the roots of orchard and farm crops. Furthermore, the irrigation ditches and reservoirs would become clogged and their capacity diminished, thus cutting down the acreage which can be cultivated.

Thus it is that even in the area of eastern Washington and northeastern Oregon, the Soil Conservation Service is facing a complex of interrelated agricultural and physical conditions, presenting problems the solution of which lies in their coordination toward maintenance of the soil itself and its fertility as the end in view. This must be done in order that the people of the region may keep for themselves and their children the standard of living won so courageously by those who settled the area.

BOOK REVIEWS AND ABSTRACTS

By Phoebe O'Neall Faris

THE FUTURE OF THE GREAT PLAINS.

Great Plains Committee. Washington, D. C. 1937.

No one knows why it is that it takes a catastrophe to awaken the human creature to a knowledege of his own shortcomings. Yet such is the case, as evidenced by drought conditions in the Great Plains areas during the years of 1934 and 1936. For a good many years cultivation methods as practiced in the region had been injuring the land to such an extent that large areas were becoming increasingly unproductive even in good years; yet nothing was done in the way of a definitely constructive program for Great Plains agriculture until drought and unprecedented dust storms swept the land, leaving in their wake ruined crops and homes and conditions so deplorable as to necessitate immediate emergency relief on the part of the Federal Government. Results of studies made under the emergency program point to urgent need for coordinated drought-control measures over a long period of time to save the soil and water of the region and for the readjustment of its agricultural life. A realization of the true conditions led to the appointment by the President of the Great Plains Committee whose studies are summarized and recommendations submitted in The Future of the Great Plains.

Judging from the report of the committee it is apparent that at present the legal aspect of the problem is particularly urgent. With thousands of farms, covering millions of acres, in such a state that they should no longer be plowed, with tenancy on the decided increase, and tax delinquencies rapidly bringing about a vicious circle of higher tax rates on a diminishing tax base; with the persistent use of high cost water for cash-crop production on lands of low productivity; with dependency on the increase and inadequate and excessively variable incomes all over the region—all these factors, coupled with a noticeable impairment of individual and community stability, emphasize the importance of coordinated Federal, State, and local legislation for future land and water utilization throughout the 10 States comprising the Great Plains.

With proper legislation for the future stability of the Great Plains in view, the need for facts as based on careful investigations and surveys is urgent and immediate: Facts concerning the past and present uses of land and water; land ownership and land tenure and cultural practices on the many and various types of land within the region; the facts about climatic risks as relating to settlement and agriculture, topography and soils; soil erosion conditions throughout the whole region and soil capacity with regard to plowing and cropping, grazing of grass lands, lands which should be left in natural cover; water supplies, both surface and underground, with irrigation possibilities as related to the needs of all small and large farms; the economic capabilities of all people not enjoying a decent standard of living.

Some of these studies are already well established under guidance of various agencies and departments of the State and Federal Governments. But, as set forth by the committee, it cannot be expected that they will achieve permanent success without uniform and adequate legislation involving local and State bodies to provide for a workable conservation program in the region. At the time the report was filed "adequate State legislation for a State-wide program of erosion control on private lands is lacking in each of the 10 States."

Only three of the Plains States—Texas, Kansas, and Oklahoma—have passed laws providing directly for erosion-control operations. The Kansas law has been declared unconstitutional by the State supreme court. The two Texas laws represent the greatest State achievement to date in legislation for soil-erosion control. As no provision is given, however, in either law, for essential changes in land use or complete methods of voluntary cooperation of the farmers, these laws fall short of requirements under the Federal policy for land readjustments and conservation of the soil and water of the Great Plains.

It becomes apparent, therefore, that in order to command substantial cooperation from landowners and farmers in the Great Plains, we must turn to State legislation to supplement the Federal programs. With this important objective in view, the President has recommended to the State legislatures the adoption of a Standard State Soil Conservation Districts Law. "In essence this law provides a procedure by which soil conservation districts may be organized. They are to be governmental subdivisions of the State. In the main they are to exercise two types of power: (1) To establish and administer erosion-control projects and preventive measures; and (2) to prescribe land-use regulations designed to prevent and control erosion. Such regulations are to have the force of law within the district."

The proposed State law, which is based on recommendations of the Land Policy Committee, the Soil Conservation Service, representatives of a number of States, and the Office of the Solicitor, is believed adequate to meet the constitutional and legal requirements of the program. Under the law local agencies for erosion control could be established, and within their respective areas they could perform intensive control operations. The lands of those who did not cooperate voluntarily in control programs could be brought within the influence of the operations, thus preventing the washing and blowing of soil from such lands onto adjacent areas engaged in erosion-control operations.

By the first of April legislation closely paralleling the Standard State Soil Conservation Districts Law had been enacted in several States in the Great Plains area.

Another legislative problem that must be solved is that providing for a sound conservation program for the retirement, proper administration, and more appropriate use of submarginal lands. According to the recommendations of the committee this legislation should include statements as to the purpose of the land acquisition, and legal methods for acquiring the land through purchase, condemnation, gift, and exchange. It should include also authorization to acquire the property and for the purchase of title. It is suggested that such legislation might well be based upon the land-acquisition programs of the States of New York and Wisconsin.

A serious problem is presented by the jumble of tax statutes now existing in the Great Plains States. In many areas tax-delinquent lands lie neglected or abandoned to misuse and erosion because of notable defects in present procedures both for acquisition by public agencies, and for their administration by such agencies after acquisition. While such a situation exists little can be done throughout the region in the way of land readjustments for control of wind erosion. Legislation for the correction of the conditions "* * * should authorize the acquiring agency to improve and manage the lands, to lease them, and to exchange them for others. Finally, provision should be made to transfer such lands from subdivisions of the State to the State, or vice versa, in order that the most appropriate agency may administer the lands for the new land uses."

It is proposed by the committee that in order to restore the range, control erosion, and stabilize the livestock industry, grazing be

BOOK REVIEWS AND ABSTRACTS
Continued

regulated by law. Since much of the soil erosion in the Plains region is directly caused by overgrazing, it is thought that grazing regulation can be made effective in any State adopting the Standard State Soil Conservation Districts Law.

For a readjustment of water utilization to land use the committee recommends immediate investigation and analysis of all forms of water districts and powers now existent in the Great Plains States. This would enable the formulation of a definite plan of legislation for uniform water control and preservation in this region where water is often scarce and every drop of it precious.

Appendices included in the report are as follows: The President's Letter of Instructions; Acknowledgments; Soil and Water Conservation in the Great Plains Typical Results of Operations Program; Benefits Derived by Areas Surrounding Irrigation Projects; The Montana Land-Use Study; A Montana Cooperative Grazing Association; A Standard State Soil Conservation Districts Law; Summary of Texas Legislation on Soil Erosion Control; Summary of the New York Plan for Developing and Preserving State Forest Land; Summary of the Taylor Grazing Act; Montana Grazing Laws of 1935, Chapter 195; Montana Grazing Laws of 1935, Chapter 194; New Mexico Legislation Relating to Underground Water; Uniform Underground Water Law for Western States Suggested by a Committee of the Western State Engineers' Association; A Brief Bibliography for the Non-Professional Reader.

RANGE IMPROVEMENT BY WATER SPREADING

(Continued from p. 270)

Drainage area of about 2 square miles on San Francisco Creek, above diversion dam. Good cover such as this extends almost to the rim rock below the mesa, which is fully 2,500 feet above the dam. The photograph was taken from the dam.

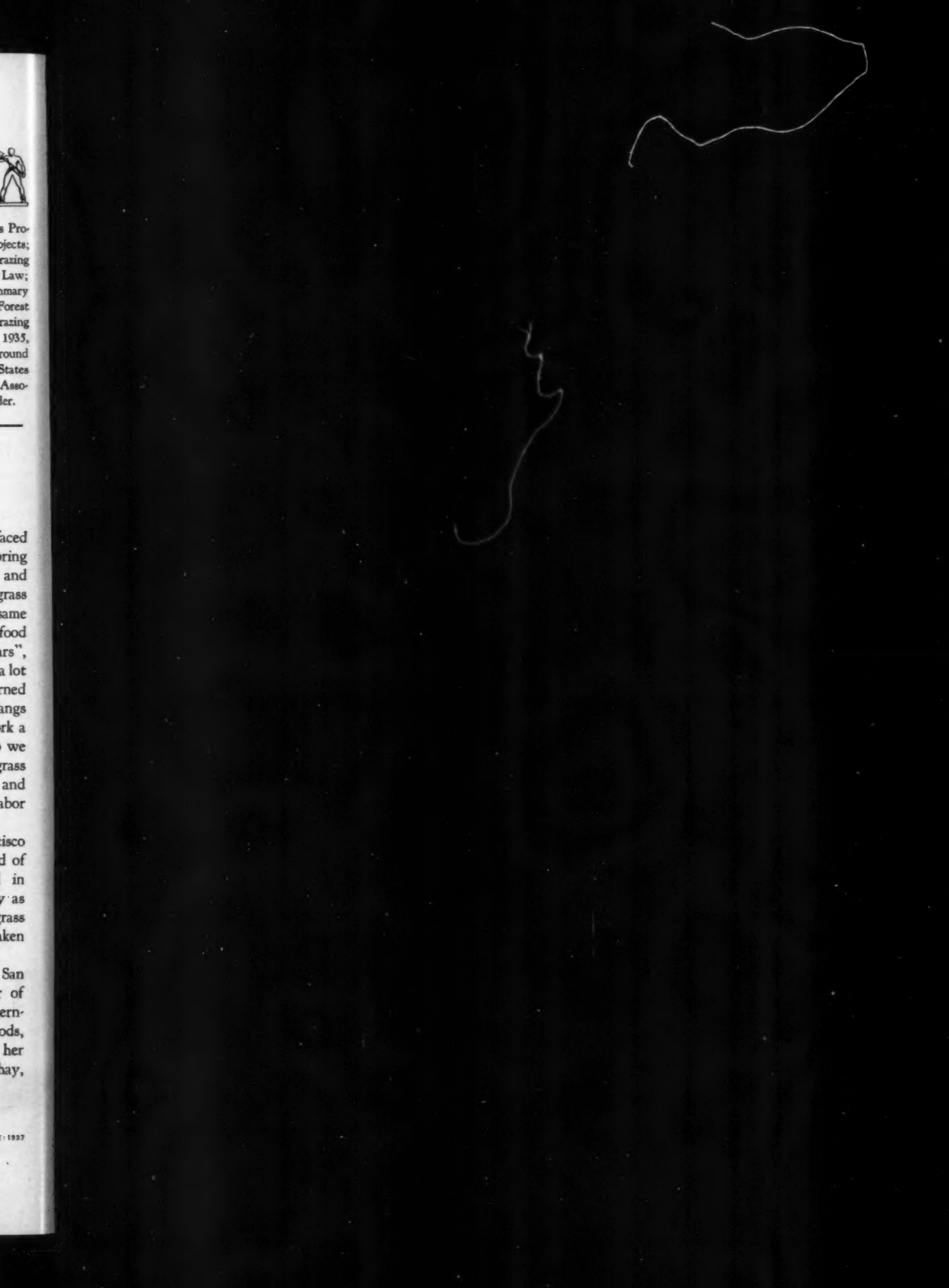
with our work at the Mexican Springs Experiment Station. Likewise, the 100 dams, diversion ditches, and spreaders are all doing their duty in the control of erosion and in protecting the neighbors lower down the drainage system from periodical floods.

"All we have to do is to lead the water to the high places, and gravitation does the rest", said Louis Cortese, "so wherever we find a low place we run a spreader furrow from it on to the next high place. Now we never have to attend an irrigation, because the spreaders do the job automatically. If we can be assured of four runs of water lasting 4 hours, occurring at regulated intervals, during the summer, we can be assured of 400 tons of hay and ample pasture under this scheme. We find, also, that closely spaced water holes usually save us grass and flesh on our cattle We arrange it so our cattle have no more than a half-mile to travel for water."

Profitable Market for Hay

Each fall these men buy 600 head of white-faced weaners, and these are sold again late the next spring after having wintered on the Cortese pastures and hay. By this program they sell their hay and grass in the most economical way possible, and at the same time the manure from the calves returns a rich food to the soil. "We've been at this job for 20 years", Louis Cortese told us, "but it has paid. It's taken a lot of elbow-grease and a lot more patience, and we learned years ago that a ranch won't pay if the owner hangs around the towns. We've made flood-control work a winter's job, and we arrange our ranch set-up so we have time to do this. The additional hay and grass grown by just removing rock from our fields and pastures to build dams and the barn, paid for the labor in moving the rock."

Today there are trees and shrubs along San Francisco Creek channel, and gullies have filled up instead of growing into gulches. Springs have appeared in parts of the creek bed which formerly were dry as bones, and in place of the sparse stands of grama grass the higher-yielding western wheatgrass has taken strong hold.

As for the contrasting streams, Frijole and San Francisco Creeks, the formera waits still a pair of Corteses. Given owners with stout hearts, discernment, and a knowledge of best stream-control methods, Frijole could, within 20 years or less, match her sister basin in the matter of fine pasture, heavy hay, and fat cattle.

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